UNLOCKING THE LEGACY OF ALBERTA'S NATURAL SCIENCE COLLECTIONS

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Abstract

Alberta's natural science collections face fundamental challenges that are part of much larger issues beyond museums and collections. University collections can thrive in the midst of these challenges by focusing on a simple theme: unlocking the legacy of our collections. This paper describes our dreams, our strategies and our progress in unlocking that legacy by building a distributed computer network that provides access to information about natural science collections objects in the province of Alberta. Knowledge summaries that act as intellectual roadmaps enhance access to basic specimen databases. A vital community of collections users energizes the network. Our aim is to build a virtual facility, for all public natural science collections in Alberta, that nurtures a dynamic, sustainable and mutually supportive balance among objects, ideas and people at multiple levels.

The Challenge of Museum Community Identity

Numerous evolving societal currents and constraints influence museums and collections in the Canadian province of Alberta. The range and interwoven complexity of these forces challenge the sustainability of museums through the changing identity, nature, and interactions of the communities that collections serve.

The diversity and ambiguity of museum communities becomes a concern when the connection between the users and the financial support of a collection is tenuous. Although collection use may be extensive, and the act of studying a collection almost always adds significant value to it, that added value may not contribute to the upkeep of the collection. Users also may be unaware that particular specimens exist, or may not be able to sort through myriad objects physically. An obvious solution to these problems is to make primary accession data on collections objects widely available online, using a medium that is ideally suited to serving diffuse and difficult-to-define communities. Serving these communities more effectively also allows them to coordinate, consolidate and connect with funding sources.

Collections supporters are not only researchers or even curious observers, but people who are attracted to the sense of time, place and the flow of history that collections impart. For these people, collections often play a key role in anchoring community identity in a multidimensional world. They house tangible touchstones and associated information that root community ideas and allow recourse to fact-based knowledge. Thus, museums and collections can help to define and create communities, as well as the reverse. But unless museums are accessible to the communities that support them, the link between people, objects and ideas will break, and it will be extremely difficult to rebuild.

The continual fragmentation and recombination of university departments and the governments or private institutions that house collections is part of the challenge of community identity. Substantial portions of collections may be unrecorded or become disorganized, and the founders who built these valuable research and teaching resources inevitably retire, sometimes without replacement. In some cases, administrative policies shift toward short-term cost recovery, jeopardizing collections that currently receive little use, but nonetheless have enormous value as long-term records of the natural history of a region. Enhanced communication and data sharing potentially can assist collections that are struggling. This is accomplished through mobilizing community support or by enhancing visibility in ways that would have been impossible without advances in computer technology and the advantages of scale provided by a larger network of collections.

Even the relationship of Albertan people with the natural world is changing rapidly. With increasing urbanization and the need to keep our footing in a maelstrom of online information and new technology, we seem to have little time left to maintain familiarity with the little things that compose our natural world. Our loss of familiarity with our natural surroundings creates a deficit in the environmental literacy that is needed to make responsible decisions about issues such as global climate change and ecological services. Museums always have served as windows to our larger natural world. Our challenge now is to provide portals that ensure that new generations will take the time to understand nature better. Paradoxically, our approach is to use computer technology to mitigate the alienation from the natural world that is due, in part, to overreliance on computer technology.

Despite, and because of, these larger challenges, there has been an increase in requests and opportunities to access collections data. Rapid access to baseline data on biodiversity and climate change indicators feeds

into more effective land and resource management. New opportunities and innovations with computing technology are arising continually in pattern recognition, data mining and wireless communication. Information access and sharing between remote communities is possible on an unprecedented scale. Furthermore, in Alberta, the timing for our project is urgent, because it transfers knowledge from a large cohort of curators who have retired recently or are nearing retirement, and appropriate, because the province of Alberta and the University of Alberta celebrate their centennials in 2005 and 2008, respectively.

Goals and Strategies

To meet the challenges of our changing communities, institutions and environment, we are proposing to build a facility that will encompass all public natural science collections in Alberta. The Alberta Natural Science Collections Information Facility (ANSCIF) will digitize, database and harmonize more than a century's worth of natural science collections information into a searchable web-based record of natural heritage. This resource will form the foundation of a community of researchers, naturalists and educators throughout Alberta, with strong integration across Canada and internationally. The facility will include all recognized collections of biodiversity or earth science objects at institutions across the province, whether educational (Olds College and the Universities of Lethbridge, Calgary and Alberta), provincial (Provincial Museum of Alberta, Royal Tyrrell Museum, Glenbow Museum and Alberta Research Council), or federal (Canadian Forest Service, Agriculture and Agri-Food Canada and Parks Canada). The distributed virtual museum at the University of Alberta[1] has served as a successful pilot project.

The ultimate goals of ANSCIF are to unite the rich natural science data resources of all participating institutions, and to act as an interface linking people (researchers, curators, students, teachers, naturalists, environmental consultants and members of the public), institutions (universities, colleges, museums, industry), and computational resources (hardware, software, enhanced content).

We hope to accomplish our goals within five years with funding applications now under review by both the Canadian Foundation for Innovation and the Alberta Science and Research Investments Program. To achieve these goals, ANSCIF partner institutions will determine and confirm key management principles, under a general Memorandum of Understanding (MOU) that formally outlines governance and collaborative team structure (Fig. 1). The MOU also will recognize that data ownership resides with publishing institutions, and it will summarize the key objectives of the facility. Prior to final approval of funding, the MOU will articulate collaborative resource sharing principles. A comprehensive internal and external communications plan will be developed, including a regular E-mail bulletin, manuals, guidelines and an annual meeting for participants.

1. Networked Databases

Foundation databases of collection objects will be the building blocks of ANSCIF. We will create a comprehensive network of databases containing collection object information for natural science collections across Alberta. Although our pilot projects at the University of Alberta currently use MultiMimsy, ANSCIF will be platform-independent and will support the use of widespread database products, such as Access, FileMaker Pro and SQL Server. Individual databases are to be housed and managed by each participating institution.

All data entries are to be anchored to individually-identified specimens curated at each institution. Each institution will be responsible for cataloguing its own collections (generally onsite) in accordance with international standards and practices of collections documentation. The pace of databasing will vary depending on the kind of specimen object (e.g., herbarium sheets will be slower than pinned insects, because more information is recorded). Quality control of data entry will be the responsibility of the curator or collection representative, with quality oversight provided by standards and evaluation subcommittees. ANSCIF will contribute to initial training and coordination of data entry technicians.

Most specimen text information will be digitized manually, but some collections may explore data entry by voice recognition and optical character recognition. Digitization of specimens may be performed to different extents and in different ways for each collection. For example, high quality two-dimensional image scans are most appropriate for pressed vascular plants, whereas three-dimensional reconstructions may be more suitable for large animal fossils.

Databases will be constructed in a manner compatible with system-wide data querying using agreed-upon metadata (data structure) standards, such as Darwin Core V2 and georeferencing guidelines such as those outlined by Global Biodiversity Information Facility (GBIF). Specific programs, processes or hardware will not otherwise be mandated. Unique and enhanced features among collections and databases will be encouraged.

2. Knowledge Summaries

Enhanced knowledge summaries for collections data and objects will be created as an integral part of ANSCIF, including species and geological type pages. Their design will allow rapid intellectual access to significant collection contents. ANSCIF participants will

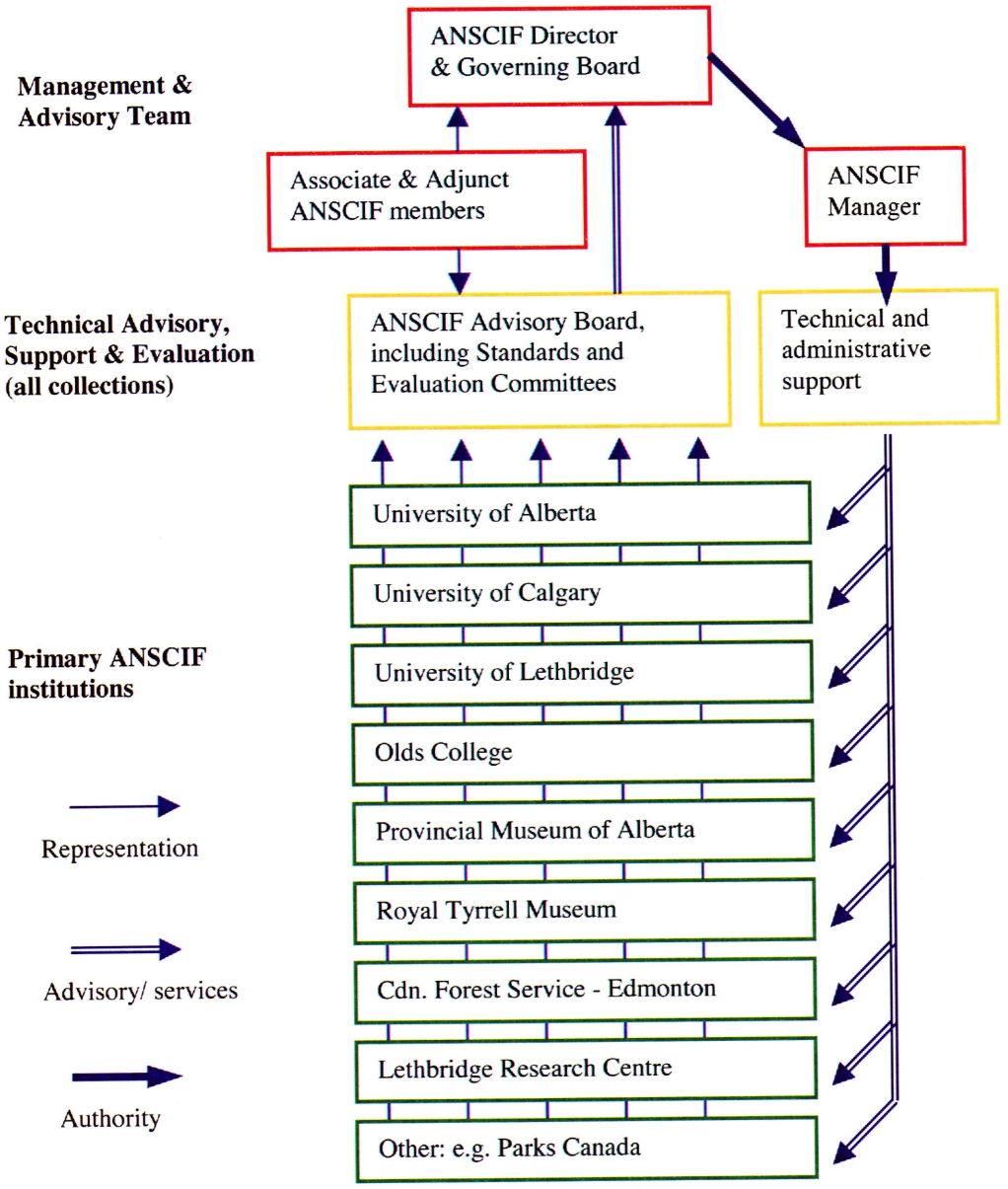


Fig. 1. Proposed ANSCIF management structure. An individual curator may serve in one or more of the following capacities: 1) Governing Board, as the Institutional Representative, and/or; 2) Advisory Board, in one or more Standards and Evaluation Committees, or as a Collection Representative. Persons representing Associate or Adjunct ANSCIF member institutions serve on one or more Standards and Evaluation Committees (SECs) and may be members of the Governing Board. SECs will include all relevant curatorial representaitves in the following disciplinary groups: 1) computing networks, 2) botany and mycology, 3) entomology, 4) invertebrates, 5) vertebrates, 6) palaeontology, 7) geology, 8) anthropology (not including human artefacts).

contribute to the production of knowledge summaries within their relevant disciplines. Knowledge summaries provide authoritative information (e.g., geographic, historical, stratigraphic, taxonomic, genetic) on a biological species or a class of earth science objects. They are comparable to naturalist field guides, but are updated continually from the entire ANSCIF network and may be tailored to meet individual user requirements. For an example of a knowledge summary for one University of Alberta collection, see the sample butterfly species page from the E.H. Strickland Entomological Museum (Fig. 2).

Knowledge summaries will be housed in a central repository, but will be created and modified locally. Participation by emeritus academics and senior naturalists will be critical for producing effective knowledge summaries to crystallize for future generations the experience and understanding of our current generation. Authors, editors, reviewers and revisers of species pages or equivalent knowledge summaries will be given credit and responsibility for their individual contributions. Knowledge summaries and associated images can be the copyright of the authors responsible for them, or they may be copyrighted by the institution where the creator is employed, in congruence with institutional policies. The same staff who curate and confirm specimen identification prior to databasing will generate knowledge summaries when feasible.

Species pages will be produced for all species for which expertise is available, including vertebrates, plants, and insects and other invertebrates. We will start with economically important or charismatic groups of organisms. Similar criteria will be used to develop earth science knowledge summaries. Dynamically-generated summaries of specimen information (high quality tables and maps) will be created for all identified species and earth science object classes.

Summary information will be derived from, and linked back to, individual specimens that are physically housed at ANSCIF institutions. Knowledge summaries will include digitized specimen images. General formats for knowledge summaries will be developed in tandem with procedural and metadata standards that will dictate which data fields may be included to best describe a species or an earth science object, and how ANSCIF-wide information should be summarized graphically.

3. Internet Access

The most efficient means for achieving the goal of uniting the natural science data resources of participating institutions is through the creation of a distributed network that is openly accessible and searchable over the Internet. The ANSCIF network will be an interoperable system of natural science databases and information repositories with a computational architecture that uses a Web Services model.[2] ANSCIF programs will be based on general web standards set by such organizations as the World Wide Web Consortium (W3C). Natural science-specific standards, such as those of the Taxonomic Database Working Group, will also be met to ensure interoperability with regional informational networks that are not necessarily specimen-based, such as the Alberta Natural Heritage Information Centre (ANHIC), the Biodiversity Species Observation Database (BSOD) and the Fish Management Information System (FMIS).

After initial development of procedural and metadata standards for the exchange of data among participants, further work will concentrate on adding and creating tools for facility-wide searching, data mining and geographic and historical modelling. Analysis may incorporate third-party analytical tools (e.g., ArcINFO). An early projected developmental step of ANSCIF will be the adoption and implementation of data exchange standards for specimen information, and optimization of interoperability with other biodiversity networks. The data exchange format will use XML (Extensible Markup Language), data exchange protocols will use SOAP (Simple Object Access Protocol) and registry services will use UDDI (Universal Description, Discovery and Integration). A central web portal will act as a gateway for ANSCIF on the web, providing a home for knowledge summaries and an overview of institution-specific features.

The existence of separate ANSCIF data nodes will be advertised actively. ANSCIF will assist in setup, training and system maintenance, but participating collections and institutions will be responsible for maintaining independent nodes. As an alternative to maintaining separate nodes, participants may collaborate with partner institutions to make their data available from a central server, either pooled with that institution or presented separately. Data ownership and the right to change previously published data will remain with the originating institutions, and specifically with the relevant curators or collection representatives. However, the University of Alberta will maintain backups of all data, in order to comply with funding agency regulations that require long-term accessibility of all data. Services and data may also be made available independently of the central portal, to enhance unique or advanced features of individual collections. Where appropriate, ANSCIF will take advantage of existing or emerging computing grids and associated technologies.

Community-wide standards and policies will guide controlled access to sensitive data (e.g., locality information for rare species). Access to basic collection object data will be free to all users of the system, but a charge may be levied for enhanced web services, such as hard-copy reproduction of species pages and associated images.

Entomology Collection

Intro Page | Search the Collection | Browse the Collection

Site Info Links Contact Us

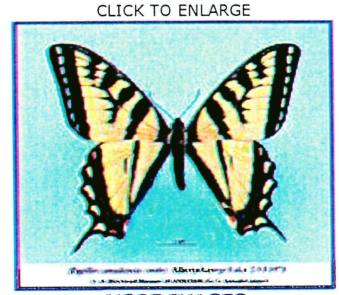
Species Page

specimen search results ->*Papilio canadensis* ->**species page**

scientific name *Papilio canadensis* Rothschild & Jordan

common name Canadian Tiger Swallowtail

CLICK TO ENLARGE



MORE IMAGES

habitat
Boreal forests and parkland aspen groves, local in the prairie grasslands.

seasonality
One brood per year, the peak flight period occurring from early June to early July.

identification
Throughout most of Alberta, there are no species that can be confused with the Canadian Tiger Swallowtail. The large size (85 - 100mm wingspan) and black stripe through the middle of the hindwing distinguish it from the Old World and Anise Swallowtails (*P. machaon* and *P. zelicaon*). In the extreme southern part of the province, from the Crowsnest region south and east to the Saskatchewan border, three other Swallowtails could be encountered that are superficially similar. The Two-tailed Swallowtail (*P. multicaudatus*) is larger (wingspan usually over 100mm), has narrower black stripes, and has two rather than one tail per hindwing. Pale or faded female P. canadensis are similar to the Pale Swallowtail (*P. eurymedon*), but the black stripes of *P. eurymedon* are much broader, and the ground colour of *eurymedon* is white or creamy white, never pale yellow. A third species may be present in the Waterton - Crowsnest area, the Western Tiger Swallowtail (*P. rutulus*), which has yellow rather than red spots along the margin of the hindwing underside. No subspecies are currently recognized.

Related Species Info

Authorship

Display Hierarchy

References

Specimen Info
There are 42 specimens of this species in the online database

Map Distribution

Adult Seasonal Distribution

Specimen List

life history
The eggs are smooth, green and round (Bird et al. 1995). Early instar larvae resemble bird droppings, while mature larvae are velvety green with a pair of eyespots and a yellow and black stripe on the mid-thoracic segment (Guppy & Shepard 2001). Pupae overwinter, and are light brown with a darker brown lateral stripe (Guppy & Shepard 2001). Males patrol along forest edges to search for females, often along the canopy or subcanopy of aspen woods, and sip moisture at mud and sand.

conservation
Not of concern, a widespread, usually common species.

diet info
Larvae feed on willows (*Salix* spp.), Trembling Aspen (*Populus tremuloides*) and cultivated crab apple (*Malus* spp.). Adults nectar at a wide variety of flowers, particularly dandelion (*Taraxacum officinale*), cultivated lilacs, dogbane (*Apocynum* spp.) and Labrador Tea (*Ledum groenlandicum*) (Hooper 1973).

range
The Canadian Tiger Swallowtail occurs through most of Canada and Alaska (but not in the high arctic), south to the northern tier of the U.S. (Opler 1999).

museums

University of Alberta E.H. Strickland Entomological Museum

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Fig. 2. Species page example. Further information on this common butterfly in Alberta may be obtained through the *Entomology Collection* web site. This web site includes high quality images of top and bottom, full lists and data for museum specimens, references linked to the University of Alberta library system, histograms of adult seasonal flight times and searchable maps with Alberta records plotted in relation to features such as habitat types and roads.

4. Conservation of Collections

Specimen storage systems (including tissue freezers) that meet modern curatorial standards will protect all ANSCIF primary member natural science collections for future generations. Cabinets, shelves and compactors will be purchased and installed for participating collections to ensure the long-term safety of specimens and objects. Long-term storage equipment for cryostorage of DNA and tissue samples will be installed, including power backup systems, where required.

Storage systems will comply with institutional policies, legislation and regulations. These include the federal Cultural Property Import and Export Act and the National Sciences and Engineering Research Council of Canada (NSERC) "Framework for Researchers Working with University-Based Collections."[3] As lead institution, the University of Alberta is designated as a Class A institution under the federal Cultural Property Act, and functions within a framework of institutionally-approved museum policies and procedures, legislation, standards of museum practice and a Board of Governors-sanctioned Collections Committee. Institutional policies on destructive sampling from specimens also may be established.

Storage equipment may be deposited on indefinite loan or given to institutions that are not the lead institution, depending on the conditions of the grant through which it was purchased.

5. Connected Communities

A key element of ANSCIF will be the empowerment of an innovative community network that sustainably supports research and training in museums and collections across Alberta. A comprehensive communications plan to be developed by ANSCIF participants will explicitly include museum information users at multiple levels. Participation of user communities will be encouraged to maximize long-term value, sustainability and growth of collections. Regular taxon-specific or collection-oriented meetings will be held in association with individual collections, and local naturalists will be recruited to assist in producing knowledge summaries. Some examples of current outreach programs combining research and training are at the University of Alberta's Department of Museums and Collections Services and the Alberta Lepidopterists' Guild.[4]

Databases will be linked to networks of biodiversity information with national nodes, including the Canadian Biodiversity Information Facility (CBIF)[5] and the Canadian Information System for the Environment (CISE),[6] and global nodes, such as the Global Biodiversity Information Facility (GBIF),[7] to maximize opportunities for broad comparisons against ANSCIF data. Extensive, accurate and locally relevant content in our publicly available databases will facilitate lifelong learning. Broader links to heritage networks worldwide will also be maintained, including those that address museum documentation standards (e.g., the Museum Computer Network, the Canadian Heritage Information Network).

The active involvement of local naturalist groups in ANSCIF will be particularly important. For example, each collections database developed to date at the University of Alberta has incorporated an extensive volunteer system drawn from the graduate and undergraduate student population and the general public (e.g., via the Friends of the University of Alberta Museums or the Alberta Lepidopterists Guild). Volunteer activities have included species identification, specimen cataloguing, data entry and creation of species pages.

Progress and Transformations

Many challenges faced by collections are the same as those that universities deal with as educational institutions. In parallel with the companion paper by Andrews and Blondheim (*in litt.* 2004), we use a condensed list of Hanna's (2003) strategic challenges as a set of criteria for evaluating our progress in repositioning collections. Hanna describes a growing problem of relevance for higher education institutions around the world as the international economy evolves toward a global network organized around the value of knowledge. He lists several strategic challenges that are transforming colleges and universities as they meet this complex, dynamic, global environment. The University of Alberta Virtual Museum was developed independently from the analysis of Hanna, and so it is instructive to assess how accurately we have anticipated the same challenges.

A number of collections at the University of Alberta and elsewhere in Alberta have made similar transformations in serving their changing communities, but space constraints prohibit a comprehensive treatment. We focus here on a single collection, the University of Alberta Strickland Museum of Entomology, to illustrate how some of the challenges articulated in Hanna have been met. The Strickland Museum started as the research collection of E.H. Strickland, who founded the Department of Entomology at the University of Alberta in 1922. This department merged into the Department of Biological Sciences in 1994, but the museum thrives in a building that also contains the largest concentration of entomological researchers on the University of Alberta campus. With about one million specimens, the Strickland Museum is tied with the collection of the University of Manitoba as the largest insect collection in western Canada. Its largest component is beetles, representing the research interests of the Emeritus Curator, Dr. George Ball. However, one of the most active parts of the Strickland Museum is now the

Bowman Collection of moths and butterflies, reflecting the recent arrival of the senior author of this article, even though the Bowman Collection was virtually unused since its acquisition from the widow of a prominent local collector in 1955. The Bowman Collection is now one of the focal points of the Alberta Lepidopterists' Guild, a group of several dozen enthusiasts from all walks of life who have been the driving force behind the development of the entomology Virtual Museum.

1. Removing Boundaries

Until recently, the physical boundaries of collections in many campuses were almost absolute. An extreme example is the collection encountered by the senior author at a major university, where a widely respected researcher sympathetic to the collection never stepped into it in 30 years, even though his office was in the same building. The museum director justified this relationship with colleagues in terms of protecting the collection from damage and interference. Now, however, it is possible to have the best of both worlds. Digital imaging and databasing can open fundamentally important parts of collections to everyone with an Internet link, even those on the other side of the planet. The removal of the barriers that surround collections has resulted in a rapid increase in the use of our collections. At the same time, even more stringent measures can be taken to ensure the physical security of the collections objects. Theoretically, enhanced accessibility could cause the need for enhanced security; however, in practice, this concern is immaterial to our entomology collections because they have relatively little commercial value. Community members who use the collection and are familiar with it will also police "their" collection. In fact, we have found that the simple act of giving entomology museum door keys to a small group of the most trusted and enthusiastic naturalists who desire regular access to the collection has had an astonishingly positive effect on the number of hours and value of their volunteer services, with no reduction of security.

2. Supporting Entrepreneurial Efforts

At the University of Alberta, the entomology Virtual Museum system has supported entrepreneurial initiative and technological adaptations at several levels. For example, a series of small, informal agreements were made with volunteers, and contracts were awarded if funding was available, to build increments of 80-200 species pages at a time, or to database about 5000 or more specimens at a time, giving a total of 1200 species pages and 46,000 specimens databased as of November 2003. Payment and/or uploading the work of volunteers to the Internet site was linked to delivery of the completed database or set of species pages and an independent assessment of the quality of the product. This resulted in amicable negotiation at the beginning of each round, with a steady increase in both amount and quality of the result over time. The people who did the work took considerable pride in their pages and sections of the database, which were easily identified in the "authorship" field of species pages and the "data entry" field of specimen databases, and they continued to fine-tune their work on their own time after completion. Writers of species pages and creators of images were encouraged to view the pages as drafts that would give an excellent opportunity for feedback from other naturalists, and ultimately to publish a hard copy of the species pages under their own name as a traditional regional taxonomic treatment or field guide in book form. They also were encouraged to cite their contributions in their CV as an electronic publication.

The entomology Virtual Museum also recognizes and works within the entrepreneurial culture of research. Most university collections, and the data associated with them, grow initially as targeted research collections developed by individual researchers. Larger, established collections in universities or free-standing museums grow by accretion, primarily by receiving collections after the end of researchers' careers. Good relations between collector and museum may need to be cultivated over a period of decades, as any premature attempt to acquire and incorporate a research collection into general collection will meet with fierce resistance, sometimes to the detriment of their research collection.

3. Customizing Services

The last decade has seen a major increase in business services that universities customize to allow independent styles of interaction. The search page in the entomology Virtual Museum, which began with a simple, limited design, has been updated repeatedly and made more effective. It is now possible to search by specimen, collector, date of collection, specimen number, species page, image or browse hierarchical lists of names. By providing multiple routes to arrive at the same objects and information, the site accommodates different learning styles and user requirements. Furthermore, programmers worked closely with naturalists and researchers to determine what they needed and could use. In particular, the browse function developed in response to requests by users, and its intuitive simplicity for visual searching has resulted in its becoming the preferred method of accessing information.

4. Connected and Lifelong Learning

The distributed, Internet-accessible nature of a virtual museum is suited ideally for distance and continuous learning. Contributors to the entomology site, such as naturalists and students who write species pages, often find that their participation becomes a journey of personal learning and growth. The lead author of this article requires students to write three to five species pages as a kind of term paper in a fourth-year undergraduate insect taxonomy course. This

exercise nurtures skills in accessing both old and new information about species, inferring life history or distributional information from label data, producing high quality images using digital cameras and specialized software and condensing information about species into an accurate and readable form. A substantial proportion of the student species pages have been of sufficient quality to warrant consideration for inclusion in the Virtual Museum. Students whose assignments are now publicly available are uniformly positive about producing something that is of such general utility to other users. The process of writing species pages has led students to dig into pre-twentieth century literature in university science libraries, investigate the names of obscure localities and track down their coordinates, trace the route of expeditions and ultimately to enter graduate programs. The experience has also led students to join naturalist groups, such as the Alberta Lepidopterists' Guild, which provide an excellent system of peer mentoring, joint field trips and monthly meetings inside or outside of the university.

5. Technology Training

The computer skills required to write species pages and to catalog accession information are sophisticated and useful. These skills include imaging with digital cameras, construction of composite images with multiple focal lengths using AutoMontage, image cleanup with Adobe Photoshop and library search skills (finding information on particular species and locating and deducing geographic coordinates for localities given on specimen labels). Data entry in Excel spreadsheets was encouraged for databasing, as this affords substantial logistic efficiency. An independently-programmed download utility allows the data to be entered automatically into the larger (MultiMimsy) database.

6. Strategic Alliances

Mutually supportive alliances with partners have made a major contribution to the development of the entomology Virtual Museum. Personnel at the Alberta Natural Heritage Information Centre (ANHIC), which is responsible for tracking species at risk as well as biodiversity inventories of prospective parks and natural areas, have provided significant amounts of databasing and species pages for the Virtual Museum. Early databasing templates were reviewed by ANHIC to ensure data field compatibility. ANHIC also has funded travel and accommodation in remote field sites for Strickland Museum and Alberta Lepidopterists' Guild members to survey locations of mutual interest. In addition to access to expertise, ANHIC has benefited from housing its voucher specimens in the Strickland Museum, and the placement of specimen data in the Virtual Museum. Specimen data from private collections of naturalists also may be made available to researchers and the world community. In addition to cooperation resulting from the development of the ANSCIF proposal in Alberta, the Strickland Museum has strategic alliances with universities, museums and institutions in other provinces nationally and internationally, including CBIF, CISE, the Biological Survey of Canada[8] and the Global Butterfly Information System.[9]

7. Measuring Quality

The quality of the information in the entomology Virtual Museum is measured in a variety of integrated ways. First, teamwork between student databasers and taxonomic experts, coupled with peer review of species pages, facilitates quality control of data. Second, utilities for building knowledge summaries, such as phenology histograms and dot maps of collection records, make it much easier to detect outlier data points. Third, naturalist groups and societies create conditions that foster motivation (though pride and even competitiveness) and the continual opportunity to improve quality through training. Fourth, easy options are given for feedback or reporting of errors via the web by listing contact people. Finally, upon funding of the larger ANSCIF project, standards and evaluation committees that are built into the governing structure will have as their mandate discipline-specific and ongoing evaluation of data quality. Most fundamentally, a clear trail that indicates who did what ensures quality in the Virtual Museum, and this encourages the assignment of both credit (and motivation) as well as a sense of responsibility.

8. Open Decision Making

Development of the entomology Virtual Museum has involved active communication over four years between a naturalist (G. Anweiler),[10] an assistant curator (D. Shpeley), a programmer (J. Whittome and also later V. Gatnicki) and a researcher (F. Sperling). Furthermore, many decisions on species page format as well as the specimen database were referred for discussion to the Alberta Lepidopterists' Guild, and advice was sought internationally. Development of ANSCIF involved a grant preparation committee of four people (the first four authors of this article), and an advisory committee consisting of a dozen people, including senior, retired administrators, the Executive Director of MACS, new researchers and department representatives. Meetings or phone conversations with other institutions occurred on an extended bilateral basis. Thus, broad representation and open decision making has been essential to the progression of both the entomology Virtual Museum and the ANSCIF proposal. Regardless of the outcome of our current funding proposals, the exercise of bringing together numerous curators, collection users and institutions has succeeded in building visibility and support for collections.

Territories, Motivation and Scale

Survival is a dynamic balance, whether it refers to individuals, institutions or civilizations, and it depends on an organizational structure that allows component modules to be stronger together than when in isolation. With the Virtual Museum pilot projects and with the ANSCIF proposal, we are confident that we have a model that allows effective integration across collections while simultaneously strengthening each separate collection. By being sensitive to preexisting jurisdictions and constituencies of the institutions that contain collections, we have supported the varied motivations that underlie the creation, curation and control of collections, regardless of scale. Our aim is not perfection, since that is a futile illusion in a changing world, but rather to survive and thrive in turbulent times, and to serve as a model for other projects to follow under similar circumstances.

The shared vision of ANSCIF is to build a sustainable, dynamic network that highlights the value of our collections to the world, and enhances their use and management. To realize that vision, we have focused on unlocking the legacy of the inherent historical and scientific value of our collections for future Albertans.

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Notes

[1] The University of Alberta Virtual Museum may be accessed through *Dig Into Our Collections*.

[2] An overview of Web Services is available through the corresponding entry in the *Webopedia Online Dictionary*.

[3] See Framework for Researchers.

[4] For greater detail, see the *University of Alberta Department of Museums and Collections Services* web site and Pohl.

[5] See the *Canadian Biodiversity Information Facility (CBIF)* web site.

[6] See the *Canadian Information System for the Environment (CISE)* web site.

[7] See the *Global Biodiversity Information Facility (GBIF)* web site.

[8] See the *Biological Survey of Canada*'s web site. This is part of the Canadian Museum of Nature.

[9] See the *Global Butterfly Information System (GloBIS)* web site.

[10] See Fig. 3.

Works Cited

Biological Survey of Canada, Terrestrial Arthropods. February 2004. Canadian Museum of Nature. www.biology.ualberta.ca/bsc/bschome.htm. Accessed 13 June 2004.

Canadian Biodiversity Information Facility (CBIF). March 2003. Government of Canada. www.cbif.gc.ca/home_e.php. Accessed 13 June 2004.

Canadian Information System for the Environment (CISE). 2004. Government of Canada. www.cise-scie.ca/english/home.cfm. Accessed 13 June 2004.

Canadian Museum of Nature. Home Page. May 2004. Ottawa, Ontario, Canada. www.nature.ca/nature_e.cfm. Accessed 13 June 2004.

Dig Into Our Collections. 2001. University of Alberta Department of Museums and Collections. www.museums.ualberta.ca/dig/. Accessed 13 June 2004.

Entomology Collection. 2004. Searchable Database of the E.H. Strickland Entomological Museum, Department of Biological Sciences, University of Alberta. www.entomology.ualberta.ca/. Accessed 13 June 2004.

Framework for Researchers. November 2000. In *National Science and Engineering Research Council of Canada (NSERC)*. www.nserc.ca/programs/framework_e.htm. Accessed 13 June 2004.

Fig. 3. Gary Anweiler, naturalist and volunteer in the Strickland Museum of Entomology, curates moth specimens. Photograph by author.

Global Biodiversity Information Facility (GBIF). 2004. GBIF Secretariat, Copenhagen, Denmark. www.gbif.org/. 13 June 2004.

Global Butterfly Information System (GloBIS). June 2003. State Museum of Natural History, Stuttgart. www.insects-online.de/gartfron.htm. Accessed 13 June 2004.

Hanna, D. 2003. Building a leadership vision: eleven strategic challenges for higher education. *Educause* 38 (4): 25-34.

Pohl, G. February 2004. *The Alberta Lepidopterists' Guild*. www.biology.ualberta.ca/old_site/uasm//alg/index.html. Accessed 13 June 2004.

University of Alberta Department of Museums and Collections Services. 2001. www.museums.ualberta.ca/museums/. Accessed 13 June 2004.

Web Services. May 2004. In *Webopedia Online Dictionary*. pcwebopedia.com/TERM/W/Web_services.html. Accessed 13 June 2004.